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(54) **Gelatinized cereal product containing oligosaccharide**

(57) A gelatinised cereal product which contains a plant material which is a source of inulin; for example chicory. Sufficient of the plant material is included to provide at least about 0.25% by weight of inulin on a dry basis. The cereal product may be used as a pet food or breakfast cereal.

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nised cereal product may include at least about 0.04% by weight of kestose; 0.04% by weight of nystose and 0.04% by weight of fructosyl-nystose.

Preferably, the gelatinised matrix further includes protein. The gelatinised cereal product preferably comprises an extrusion cooked product. The extrusion cooked product may be in dried pellet form, dried expanded form, or flaked form.

In a further aspect, this invention provides a process of preparing a gelatinised cereal product which contains at least about 0.25% by weight of inulin on a dry matter basis, the process comprising gelatinising a starch source, a protein source, and a plant material which is a source of inulin to form a gelatinised starch and protein matrix which contains the inulin.

Preferably the starch source, protein source, and plant material are extrusion cooked and then extruded. Further, the extrudate may be dried.

In another aspect, this invention provides a method of increasing the digestibility of a cereal product comprising incorporating a plant material which is a source of inulin into the cereal product.

In a yet further aspect, this invention provides a method of decreasing faecal volume of a pet, the method comprising feeding the pet a gelatinised cereal product which contains an amount of a plant material which is a source of inulin, sufficient to provide at least about 0.25% by weight inulin, on a dry matter basis.

Embodiments of the invention are now described, by way of example only.

The invention provides a gelatinised cereal product which contains an amount of a plant material, which is a source of inulin, sufficient to provide at least about 0.25% by weight inulin, on a dry matter basis. The plant material used may be any suitable source of inulin; for example chicory, Jerusalem artichoke, leek, onion, yacon, asparagus which contains high levels of inulin, and mixtures of these plants. However inulin rich plant materials such as chicory and Jerusalem artichoke are preferred; especially chicory. These plant materials usually comprise at least about 50% by weight of inulin. For ease of handling, the plant material is preferably in a dried, comminuted form. For simplicity of description, the processes described below are described with reference to the use of dried, comminuted chicory. However it is to be understood that any suitable plant material may be used in any suitable form.

The remaining ingredients included in the gelatinised cereal product may be any suitable ingredients commonly used in gelatinised cereal products. Usually these ingredients include a starch source and a protein source. Suitable starch sources are, for example, grains such as corn, rice, wheat, beets, barley, oats, soy, and mixtures of these. Suitable protein sources may be selected from any suitable animal or vegetable protein source; for example meat meal, bone meal, fish meal, soy protein concentrates, milk proteins, gluten, and the like. The choice of the starch and protein sources will be largely determined by the nutritional needs of the animal or human, palatability considerations, and the type of cereal product produced. Various other ingredients, for example, sugar, salt, spices, seasonings, vitamins, minerals, flavouring agents, fats and the like may also be incorporated into the gelatinised cereal product as desired.

The gelatinised cereal product may be produced in many different ways as desired. However, for a dried cereal product, an especially suitable way of producing the product is extrusion cooking. This may be done as is well known in the art. For example, in one suitable process, a feed mixture is fed into a preconditioner. The feed mixture is primarily made up of a starch source, a protein source, and the chicory. Preferably the chicory comprises at least about 1% by weight of the feed material; more preferably at least about 2% by weight. The maximum of chicory is preferably about 20% by weight; especially about 10% by weight.

In the preconditioner, water or steam, or both, is mixed into the feed mixture. Sufficient water or steam is mixed into the feed mixture to moisten the feed mixture. If desired, the temperature of the feed mixture may be raised in the preconditioner to about 60°C to about 90°C by weight. A suitable preconditioner is described in US patent 4,752,139. Plainly, it is not necessary to use a preconditioner.

The moistened feed leaving the preconditioner is then fed into an extruder. The extruder may be any suitable single or twin screw, cooking-extruder. Suitable extruders may be obtained from Wenger Manufacturing Inc. Clextral SA, Bühler AG, and the like. During passage through the extruder, the moistened feed passes through a cooking zone, in which it is subjected to mechanical shear and is heated; for example up to a maximum temperature of up to about 150°C, and a forming zone. The gauge pressure in the forming zone is about 300 kPa to about 10 MPa as desired. If desired, water or steam, or both, may be introduced into the cooking zone. During passage through the extruder, the starch source of the moistened feed is gelatinised to provide a gelatinised matrix structure primarily of starch, protein and chicory.

The gelatinised matrix leaving the extruder is forced through a suitable die; for example a die as described in European patent application 0685051; the disclosure of which is incorporated by reference. A shaped extrudate, which has a cross-sectional shape corresponding to that of the orifice of the die, leaves the die. Depending upon the conditions in the extruder and the starch source used, the shaped extrudate expands to a greater or lesser extent. The shaped extrudate is then cut into pieces using blades. The individual pieces are then dried and, if desired, coated with protective or flavouring agents, or both. After cooling, the pieces may be packed into suitable packages. Alternatively, the individual pieces may be formed into flakes and then dried.

Depending upon the ingredients used, the gelatinised cereal product may be in the form of dried kibbles suitable

The meat emulsion is then heated to a temperature above about 65°C in a mixer-cooker. Steam may be injected into the meat batter if desired. The heated meat emulsion is then again emulsified to provide a loaf batter and the loaf batter maintained at a temperature above about 60°C until filling into cans.

It will be appreciated that the gelatinised cereal product may be produced by any suitable process and not only those described above. Other types of oligosaccharides may also be included in the gelatinised cereal product; for example fructo oligosaccharide and soy oligosaccharide. The soy oligosaccharides may be added in the form of soy meal or other suitable soy source.

The cereal products may be in any suitable form; for example dried, semi-wet and wet. However, the matrix making up the cereal product must be gelatinised in order to remove or destroy the sesquiterpene compounds present in the inulin-containing plant material.

Specific examples are now described for further illustration.

Example 1

A feed mixture is made up of about 58% by weight corn, about 5.5% by weight of corn gluten, about 22% by weight of chicken and fish meal, dried chicory and salts, vitamins and minerals making up the remainder. Two levels of chicory are used; about 2.5% and about 5%. Also, two commercial types of chicory are used; Leroux standard blend and Leroux Rubis variety. Both types are commercially available on the French market from the Leroux company.

The feed mixture is fed into a preconditioner and moistened. The moistened feed leaving the preconditioner is then fed into an extruder-cooker and gelatinised. The gelatinised matrix leaving the extruder is force through a die and extruded. The extrudate leaving the die head is cut into pieces suitable for feeding to cats, dried, and cooled to pellets.

The pellets are fed to a panel of 80 cats. For comparison, the cats may choose between the pellets with chicory and control pellets which are identical except that they do not contain chicory. The amount that each cat eats of each type of pellet is monitored. The results are as follows:

Example No	Chicory Type	Chicory level %	Percentage consuming pellets containing chicory
1A	Standard	2.5	42
1B	Standard	5.0	52
1C	Rubis	2.5	46
1D	Rubis	5.0	52

The results indicate that the pellets with chicory have substantially the same palatability as those without. However, even more surprisingly, as the chicory content increases, the palatability appears to increase.

The gut flora of the cats is analysed and it is determined that bifidobacteria counts have increased while *C. perfringens* counts have decreased. Further, faecal pH and odours are found to have decreased. Energy and mineral digestibility have increased leading to a decrease in faecal volume.

The pellets are crushed and extracted with methanol by boiling under reflux for 1 hour. The extract is twice partitioned between water and chloroform and santonin is added. The chloroform phase is separated, dried and evaporated. The residue is dissolved in a mixture of methanol and chloroform and analysed using HPLC for free sesquiterpene lactones. The water phase is run through a column and glycosylated compounds eluted from the column using methanol. The eluant is evaporated, dissolved in water and treated with cellulase at 40°C for 2 hours. Santonin is added to the hydrolysate and the mixture extracted with ethyl acetate. The mixture is then analysed using HPLC for bound sesquiterpene lactones.

No sesquiterpene lactones are detected. Similar analysis of the chicory starting ingredient reveals between 130 to 350 ppm free sesquiterpene lactones and between 380 to 680 ppm bound sesquiterpene lactones.

Example 2

A trial is conducted using 30 dogs. The control food is the Friskies Menu Energy product, which is dried dog food available on the market. Two test foods are prepared; they correspond to the Friskies Menu Energy product except that they include 5% by weight of chicory. One test food contains the Leroux standard blend chicory and the other contains

Example 5

A trial is conducted using 16 dogs. The control food is the Friskies Menu Vitality product, which is dried dog food available on the market. A test food is prepared which correspond to the Friskies Menu Vitality product except that it include 3% by weight of Leroux standard blend chicory.

Eight dogs are fed the control food and eight dogs are fed the test food. Feces samples are collected from each dog, heated for 2 hours at 30°C, and the compounds released trapped on a Tenax tube. The trapped compounds are desorbed on a gas chromatograph. The levels of dimethylsulphide, dimethyldisulphide, and dimethyltrisulphide are determined as follows:

Food	Dimethylsulphide Area	Dimethyldisulphide Area	Dimethyltrisulphide Area
Control	5731312	1084439	379164
Test	1719824	48824	43739

The results indicate that the feces of the dogs fed the test diet have much reduced amounts of those sulfur containing compounds which are believe to cause unpleasant odors.

The levels of short chain fatty acids in the feces are also determined by gas chromatograph as follows:

Food	Acetate Area	Propionate Area	Butyrate Area	Total Area
Control	120	66	20	207
Test	159	91	18	267

The results indicate that the dogs fed the test diet have higher levels of short chain fatty acids in the gut. Short chain fatty acids are important nutrients for gut cells, the liver and muscles. An increase in the content of short chain fatty acids in the gut may result in an improvement in the health of the animal or human.

Claims

1. A cereal product which comprises a gelatinised starch matrix which contains a plant material which is a source of inulin in an amount sufficient to provide at least about 0.25% by weight inulin, on a dry matter basis.
2. A cereal product according to claim 1 in which the gelatinised starch matrix includes protein.
3. A cereal product according to claim 1 or claim 2 which is a pet food pellet.
4. A cereal product according to claim 1 or claim 2 which is in the form of expanded breakfast cereal pieces or breakfast cereal flakes.
5. A cereal product according to any one of claims 1 to 5 in which the plant material is chicory or Jerusalem artichoke.
6. A cereal product according to any one of claims 1 to 5 which comprises at least 0.5% by weight of inulin, on a dry basis.
7. A cereal product according to any of claims 1 to 6 which comprises at least about 0.1% by weight of kestose, nystose and fructosyl-nystose.
8. A process of preparing a cereal product which contains at least about 0.25% by weight of inulin on a dry basis, the process comprising gelatinising a starch source, a protein source, and a plant material which is a source of inulin, to form a gelatinised starch and protein matrix which contains the inulin.



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EUROPEAN SEARCH REPORT

Application Number
EP 97 20 3871

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	GB 2 291 580 A (WURZENER NAHRUNGSMITTEL GMBH) * page 3, paragraph 4 - page 4, paragraph 2 * * page 4, paragraph 5 * * example * * claims 1-11 *	1,4-7	A23K1/14 A23K1/18 A23L1/164 A23L1/18 A23L1/0528
X	DE 38 15 950 A (JUCHEM FRANZ GMBH & CO KG) * the whole document *	1	
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X	US 5 258 195 A (LOHAN MICHAEL J) * column 2, line 3 - column 3, line 13 * * column 3, line 50 - column 4, line 43 * * example * * claims 1-8 *	1,5-7	
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The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 3 April 1998	Examiner Dekeirel, M
CATEGORY OF CITED DOCUMENTS		T theory or principle underlying the invention E earlier patent document, but published on, or after the filing date D document cited in the application L document cited for other reasons & member of the same patent family, corresponding document	
X particularly relevant if taken alone Y particularly relevant if combined with another document of the same category A technological background O non-written disclosure P intermediate document			

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	<p>DATABASE WPI Section Ch. Derwent Publications Ltd., London, GB; Class B00, AN 67-08602H XP002029007 & JP 44 027 836 B (TAKEYAMA T AND TAKEYAMA Y) * abstract *</p> <p>-----</p>	1,10	
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The present search report has been drawn up for all claims			Examiner
Place of search THE HAGUE		Date of completion of the search 3 April 1998	Dekeirel, M
CATEGORY OF CITED DOCUMENTS			
<p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p>		<p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons * : member of the same patent family, corresponding document</p>	